REMARKS

This amendment responds to an Office Action dated April 10, 2002, in the above-identified patent application. Claims 1-19 were filed in the original application. Claims 9-11 and 13-19 have been withdrawn from consideration. By this response, Claims 9-11 and 13-19 have been cancelled. Applicants have added new claims 20-22. Claims 1-8, 12 and 20-22 are under consideration in the application, of which claims 1, 20 and 22 are in independent form. No claims are currently allowed. This Response is being filed within four months of the Office Action outstanding. Accordingly, a Request for a One-Month Time Extension is included herewith. No new claim fees are required. Applicants request that the fee required for the one-month time extension be withdrawn from Applicant's Deposit Account No. 19-1457.

In the Office Action dated April 10, 2002, the Examiner rejects Applicants claims 1-8 and 12 under 35 U.S.C. 103(a) as being allegedly unpatentable over Zhang et al. (U.S. Patent 5,569,610) in view of the applicants' admitted prior art, and Venkatesan et al. (U.S. Patent 5,371,382 [sic]). Applicants respectfully disagree.

The Examiner's rejection of Applicants' claims incorrectly characterizes and combines the prior art, and is an improper use of hindsight. In particular, the Examiner is combining steps of the Zhang and Venkatesan references, together with teachings of the Background section of Applicant's specification, without teaching or suggestion by these references. In other words, the caselaw does not support the Examiner's modification of Zhang by selecting individual method steps from the cited references and, therefore, the Examiner has not met his burden of proving obviousness. Moreover, even if the teachings of the references were combined, the combination of references still do not teach or suggest Applicants' claimed invention.

35 U.S.C. Section 103(a) explicitly precludes the use of hindsight by requiring that nonobviousness be assessed "at the time the invention was made." The courts have observed this prohibition and the Federal Circuit has repeatedly admonished the lower courts to avoid hindsight. *In re Fine*, 837 F.2d 1071, 1074 (Fed. Cir. 1988) ("One cannot use hindsight reconstruction to pick and choose among isolated discloses in the prior art to deprecate the claimed invention"); *Uniroyal, Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 1051, (Fed. Cir.) *cert. denied* 488 U.S. 825 (1988)

(the district court "impermissibly used hindsight to reconstruct the claimed invention"); *Panduit Corp. v. Dennison Manufacturing Co.*, 810 F.2d 1561, 1566 (Fed. Cir. 1987); *In re Dow Chemical Co.*, 837 F.2d 469, 473 (Fed. Cir. 1985) ("selective hindsight is no more applicable to the design of experiments than it is to the combination of prior art teachings. There must a reason or suggestion in the art for selecting the procedure used, other than the knowledge learned from the applicant's disclosure") (emphasis added) (Citation omitted); *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1553 (Fed. Cir. 1983), *cert. denied* 469 U.S. 851 (1984) (warning against "the insidious effect of hindsight syndrome wherein that which only the inventor taught is used against its teacher"); *In re Fine*, 837 F.2d 1071, 1075 (Fed. Cir. 1988), quoting *ACS Hospital Systems, Inc. V. Montefiore Hospital*, 732 F.2d 1572, 1577 (Fed. Cir. 1984) (An invention is not obvious simply because its elements appear separately in the prior art, there must be "some teaching or suggestion supporting the combination."); *Fromson v. Advance Offset Plate, Inc.*, 755 F.2d 1549, 1556 (Fed. Cir. 1985), quoting *Lindermann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 1462 (Fed. Cir. 1984) (The critical inquiry is whether "there is something

in the prior art as a whole *to suggest* the desirability, and thus the obviousness, of making the combination.") (Emphasis in original). With this burden of proof in mind, we address Applicants' claimed invention.

Applicants' claim 1 recites "depositing an amorphous silicon film on the substrate by the process of physical vapor deposition" and then the separate step of "introducing a metal catalyst to the amorphous silicon film." These two steps recite two limitations not found in the prior art.

First, the use of physical vapor deposition (PVD) to form the amorphous silicon layer is claimed. As recited by Applicants in numerous locations throughout the patent application, the use of PVD to form the amorphous silicon film gives unexpected and beneficial results over amorphous silicon films formed by CVD. In particular, Applicants refer the Examiner to page 18, line 10, through page 19, line 5, of Applicants' specification:

> "The process of producing the PVD-Si precursor film and the film's physical properties will now be described. The [amorphous silicon] a-Si precursor of the present invention is an a-Si film deposited using physical vapor deposition (PVD). In other words, PVD technology is utilized for the formation of the thin silicon film that is used as the active layer of the TFT

> device. This type of silicon material is very difficult to crystallize by [solid phase crystallization] SPC alone, due to the way in which the film is deposited. When silicon is sputtered, two phenomena occur which relate to the physical properties of the film. First, silicon atoms arrive on the surface of the forming films having a higher energy than in relevant, chemical deposition methods. This energy is imparted to the film creating collision cascades and resulting in structural damage to the film. This structural damage is similar to the damage experienced by a film subjected to ion implantation. However, the amount of damage to the film during PVD is lower than during ion implantation due to the lower energy of the arriving silicon species during PVD. Second, energetic neutral atoms of the plasma forming gas reflected from the target reach the film and also impart their energy and contribute to the structural changes in the film. As a result of these two phenomena, the structural disorder in the film increases, making it particularly difficult to form stable nuclei and commence solid phase crystalline growth when the film is subjected to a thermal anneal. **Surprisingly, however, the structural disorder in the film does not prohibit crystallization by the method of metal induced crystallization**." (emphasis added).

In a second step, the metal catalyst is introduced to the previously formed "amorphous silicon film." Applicants' two step process, wherein the amorphous silicon film is initially formed without having catalytic material formed therein, is important due to utilization of a barrier layer later in the process to form windows. Specifically,

the catalytic material may be subsequently added to the amorphous silicon film in selected regions, as recited in Applicants' dependent claim 12. None of the references cited by the Examiner teach, first, "depositing an amorphous silicon film on the substrate by the process of physical vapor deposition" and then, second, a separate step of "introducing a metal catalyst to the amorphous silicon film."

The Examiner's rejection of Applicants' claims incorrectly characterizes the prior art and is an improper use of hindsight. In particular, the Examiner states that the Zhang reference teaches "depositing an amorphous silicon film 12 by the process of physical vapor deposition such as sputtering on the substrate" and then "introducing a metal catalyst into the amorphous silicon film." As support for this statement the Examiner states, "See figures 1A-1E, 2A-2E, 4A-4E and 5A-5E and col. 1, line 20 to col. 11, line 50." Accordingly, with the exception of FIG. 3, the Examiner has cited the entire specification of Zhang without giving a citation to a specific figure, paragraph, or even to a specific column of the patent. The Examiner has given no guidance as to which paragraph or

even which column the Examiner is relying on in the Zhang reference.

Each of Zhang's four examples recite forming an amorphous silicon film by low pressure chemical vapor deposition (LPCVD), a very different process than Applicants' process utilizing physical vapor deposition (PVD). Applicants' Background section does not even address physical vapor deposition. The Venkatesan et al. reference does not teach or suggest a two step process of "depositing an amorphous silicon film on the substrate by the process of physical vapor deposition" and then a separate step of "introducing a metal catalyst to the amorphous silicon film." In particular, Venkatesan does not teach or suggest "introducing a metal catalyst to the amorphous silicon film." Venkatesan is directed toward doping using Boron and Arsenic to create a rectifying contact. Venkatesan is not concerned with exploiting different crystallization speeds between a catalyzed region and a non-catalyzed region. One skilled in the art would not look to Venkatesan's method of creating a rectifying contact using "dopants" which remain in the film, in order to improve a method of reducing crystallization by solid

phase crystallization using a metal "catalyst" that preferably is completely depleted.

Even though the Examiner has not specifically cited any paragraph or sentence of the Zhang reference, the Examiner appears to have marked a portion of the Zhang reference at column 2, line 67 through column 3, line 2, which states "When the amorphous silicon film is formed by physical vapor deposition such as sputtering, the catalytic material may be added to the target or evaporation source for forming a film." This single sentence of Zhang appears to be a typographical error. This section of Zhang discusses fabrication of the catalytic film, not the amorphous silicon film. Moreover, as stated above, each example of Zhang recites that the amorphous silicon film is manufactured by the process of LPCVD, a very different process that Applicants' PVD process. Even if this single sentence of Zhang is held to teach forming an amorphous silicon film by physical vapor deposition, the sentence teaches a single step where the amorphous silicon film and the metal catalytic material are formed together in a step by the process of physical vapor deposition. (The catalytic material is "added to the target or evaporation source." col. 3, line 2) Similarly, Venkatesan teaches a one step

process wherein the Boron and Arsenic dopants are sputtered in a single step with the silicon. ("Sputter deposited B-doped and As-doped amorphous silicon contacts about 2000 Angstroms thick were formed on the natural IIb diamond samples." col.6, lines 5-17.)

In summary, the Examiner has modified the teachings of Zhang by stating that Zhang teaches first "depositing an amorphous silicon film on the substrate by the process of physical vapor deposition" and then a second, separate step of "introducing a metal catalyst to the amorphous silicon film." However, Zhang does not teach or suggest a PVD process. Even if the single sentence of Zhang, which appears to be a typographical error, is held to be a teaching of a PVD process, Zhang does not teach the two step process of Applicants' claim 1. Venkatsan does not teach or suggest "introducing a metal catalyst to the amorphous silicon film." Even if steps from this very different process are combined with Zhang, Venkatesan also teaches a single step wherein the Boron and Arsenic are deposited together with the amorphous silicon. Applicants' Background section does not even address a PVD process. There is no teaching or suggestion whatsoever in any of the cited references of depositing an amorphous silicon fil on

a substrate by PVD and then introducing a metal catalyst. Accordingly, none of the three cited references teach or suggest Applicants' two step method as recited in claim 1 and Applicants respectfully requests allowance of independent claim 1, and corresponding dependent claims 2-8 and 12.

Several of the dependent claims will now be addressed separately.

With regard to Applicants' claim 7, none of the cited references teach or suggest, in combination with the other limitations of the claim, an annealing step conducted "at a temperature greater than 650 °C and for a time period greater than 200 seconds." As shown in Applicants' numerous figures, and in particular in figure 3, only Applicants' unique process results in crystallization of the amorphous silicon film by pure metal induced crystallization at these process temperatures and time periods. None of the three cited references teach or suggest Applicants method as recited in dependent claim 7 and for this separate reason Applicants respectfully request allowance of dependent claim 7.

With regard to Applicants' claim 8, none of the cited references teach or suggest, in combination with the

other limitations of the claim, an annealing step that "produces a crystallization growth front length of at least 80 m." This growth front is made possible by the unique outcome of Applicants' two step process wherein the amorphous silicon is first deposited by PVD, and then the metal catalyst is introduced to the silicon in a second step. The Examiner's assertion that such a growth front may be achieved through "routine experimentation and optimization" completely ignores the differences between Zhang's CVD process and Applicants' two step PVD process. None of the three cited references teach or suggest a method that achieves the growth front recited in claim 8 and for this separate reason Applicants respectfully request allowance of dependent claim 8.

With regard to Applicants' claim 12, none of the cited references teach or suggest, "providing a barrier layer on said amorphous silicon film wherein said barrier layer includes a window therein for the introduction of said catalyst to said amorphous silicon film," wherein the amorphous silicon layer has been deposited by PVD. Accordingly, none of the three cited references teach or suggest Applicants method as recited in dependent claim 12

and for this separate reason Applicants respectfully request allowance of dependent claim 12.

By this Response Applicants have added new claims 20-22. New independent claim 20 recites the limitations of original claim 1 as filed and the additional limitation "wherein the annealing step is conducted at a temperature greater than 650 °C and for a time period greater than 200 seconds and less than 800 seconds." Support for this claim is found in the specification on page 17, lines 14-16 and in Figure 3. None of the cited references teach or suggest these limitations and Applicants respectfully request allowance of new claim 20.

New claim 21 recites the metal catalysts that may be used in the method of the present invention. Support for this claim is found in the specification on page 7, lines 17-20. None of the cited references teach or suggest these catalysts, together with the limitations of claim 1 as filed, and Applicants respectfully request allowance of new claim 21.

New claim 22 recites "A method of fabricating a polysilicon film, comprising the steps of: providing a substrate; depositing an amorphous silicon film on the substrate by the process of physical vapor deposition; after deposition of said amorphous silicon film, depositing a

metal catalyst film on selected regions of the amorphous silicon film; and annealing the amorphous silicon film and the metal catalyst film to form a crystallized silicon film by pure metal induced crystallization in said selected regions." None of the cited references teach or suggest these limitations and Applicants respectfully request allowance of new claim 22.

Applicants respectfully request entry of this Amendment and consideration of the application as amended.

Respectfully submitted,

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Appendix A

The following pages 16-17 of the present Response indicates the changes to the claims made herein in application Serial Number 09/696,813, filed October 25, 2000

Deleted material is indicated in brackets [ ] and added material is underlined.

20. (Newly Added) A method of fabricating a polysilicon film, comprising the steps of:

providing a substrate;

depositing an amorphous silicon film on the substrate by the process of physical vapor deposition;

depositing a metal catalyst film on the amorphous silicon film; and

annealing the amorphous silicon film to form a crystallized region by pure metal induced crystallization, wherein the annealing step is conducted at a temperature greater than 650 °C and for a time period greater than 200 seconds and less than 800 seconds.

21. (Newly Added) The method of claim 1 wherein said metal catalyst is chosen from the group consisting of

aluminum, indium tin oxide, nickel, cobalt, palladium and germanium.

22. (Newly Added) A method of fabricating a polysilicon film, comprising the steps of:

providing a substrate;

depositing an amorphous silicon film on the substrate by the process of physical vapor deposition;

after deposition of said amorphous silicon film, depositing a metal catalyst film on selected regions of the amorphous silicon film; and

annealing the amorphous silicon film and the metal catalyst film to form a crystallized silicon film by pure metal induced crystallization in said selected regions.

Appendix B

The following pages 18-21 of the present Response contain a full set of the pending claims in application Serial Number 09/696,813, filed October 25, 2000, incorporating all changes to the claims made in prior amendments and herein

1. A method of fabricating a polysilicon film, comprising the steps of:

providing a substrate;

depositing an amorphous silicon film on the substrate by the process of physical vapor deposition;

introducing a metal catalyst to the amorphous silicon film; and

annealing the amorphous silicon film to form a crystallized region by pure metal induced crystallization.

2. The method of claim 1 further comprising the step of irradiating the crystallized region with an excimer laser after the step of annealing the amorphous silicon film.

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3. The method of claim 1 further comprising the step of fabricating a thin film transistor in the crystallized region.

4. The method of claim 1 further comprising the step of utilizing the crystallized region in a liquid crystal display.

5. The method of claim 1 wherein the amorphous silicon film is deposited using Argon as a sputtering gas, and wherein the Argon content in the amorphous silicon film after the deposition step is in the range of $2x10^{18}$ at/cm^3 to $5x10^{21}$ at/cm^3.

6. The method of claim 1 wherein the amorphous silicon film is deposited using Argon as a sputtering gas, and wherein the Argon content in the crystallized region after the annealing step is in the range of $2x10^{18}$ at/cm^3 to $5x10^{20}$ at/cm^3.

7. The method of claim 1 wherein the annealing step is conducted at a temperature greater than 650 °C and for a time period greater than 200 seconds.

8. The method of claim 1 wherein the annealing step produces a crystallization growth front length of at least 80 μm.

12. The method of claim 1 further comprising the step of providing a barrier layer on said amorphous silicon film wherein said barrier layer includes a window therein for the introduction of said catalyst to said amorphous silicon film.

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20. A method of fabricating a polysilicon film, comprising the steps of:

providing a substrate;

depositing an amorphous silicon film on the substrate by the process of physical vapor deposition;

depositing a metal catalyst film on the amorphous silicon film; and

annealing the amorphous silicon film to form a crystallized region by pure metal induced crystallization, wherein the annealing step is conducted at a temperature greater than 650 °C and for a time period greater than 200 seconds and less than 800 seconds.

21. The method of claim 1 wherein said metal catalyst is chosen from the group consisting of aluminum, indium tin oxide, nickel, cobalt, palladium and germanium.

22. A method of fabricating a polysilicon film, comprising the steps of:

providing a substrate;

depositing an amorphous silicon film on the substrate by the process of physical vapor deposition;

after deposition of said amorphous silicon film, depositing a metal catalyst film on selected regions of the amorphous silicon film; and

annealing the amorphous silicon film and the metal catalyst film to form a crystallized silicon film by pure metal induced crystallization in said selected regions.